

This lesson is part of a larger, comprehensive school garden guide called **Minnesota School Gardens: A Guide to Gardening and Plant Science** developed by Minnesota Agriculture in the Classroom in 2013. The entire guide is available at www.mda.state.mn.us/maitc.



Grade

Elementary K-5

Materials/Preparation

- ☐ Teacher Material A – Class Results – one per teacher
- ☐ Handout A – Magic Beans Problem Solving – one per student
- ☐ Optional: *Jack and the Beanstalk* by Ann Keay Beneduce, Gennady Spirin
- ☐ Beans (pole beans such as limas or scarlet runners are best)
- ☐ Optional: *Unearthing Garden Mysteries: Experiments for Kids* by Ellen Talmage
- ☐ Potting mix
- ☐ 4" or 6" pots
- ☐ Notebooks
- ☐ Writing instruments

Fun Fact

Green beans are actually the pods and seeds of immature dry beans, and their pods can be flat, oval, or rounded. Varieties called "green" beans are bred to have a juicier, more tender pod than the types used for dry beans.



Magic Beans and Giant Plants

Minnesota K-12 Academic Standards

Science	0.1.1.2 2.1.1.2 3.1.1.2 5.1.1.2	Scientific inquiry is a set of interrelated processes incorporating multiple approaches that are used to pose questions about the natural world and investigate phenomena.
Language Arts	3.6.7.7	Conduct short research projects that build knowledge about a topic.
Language Arts	4.6.7.7	Conduct short research projects that build knowledge through investigation of different aspects of a topic.
Language Arts	5.6.7.7	Conduct short research projects that use several sources to build knowledge through investigation of different aspects of a topic.

Summary/Overview

After predicting what, other than magic, caused Jack's beanstalk to grow so tall, students design and conduct experiments to explore how different conditions affect plant growth. This open-ended investigation of conditions for plant growth assumes some student knowledge of basic plant needs (light, water, etc.). It can be a springboard for more in-depth investigations of these factors.

Garden Connection

Students experiment with growing plants and the factors that influence their growth.

Background Information

Like all living things, green plants have basic needs. If light, water, air, nutrients, and an adequate temperature range are not available, plants cannot thrive and grow.

Light energy is required for *photosynthesis*, in which plants make sugars in the leaves. Light also triggers changes, particularly flowering, in certain plants.

Water is necessary to carry dissolved nutrients into the plant through the roots. It is one of the key ingredients in the process of photosynthesis, and helps the plant release energy from stored food when needed. Water pressure in plant cells, which are 65 to 95 percent water, supports stems and leaves. Water transports nutrients and gasses into, around, and out of the plant. It is an important component in the cells of all living things.

Plants require two of the components of air. They use carbon dioxide to make food (photosynthesis), and they use oxygen, as do humans and

other animals, to release the energy from that food (respiration).

Plants require mineral nutrients for growth, repair, and proper functioning. Mineral nutrients are formed by the breakdown of rocks and other materials in the earth. While humans get these minerals from plants, animals, or in the form of supplements, plants take these minerals from the soil (dissolved in water) or through fertilizers applied by humans. Although these minerals are important supplements for health and maintenance, they cannot replace the sugars produced in the leaves, which can also be stored as carbohydrates, fats, and proteins.

Objectives

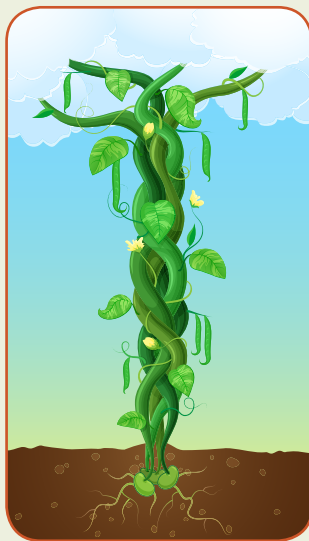
- To consider which specific conditions might affect plant growth.
- To design and conduct experiments using a problem-solving process.
- To understand that different types of conditions influence the health and growth of living things.

Procedure

Interest Approach

Tell your students a version of *Jack and the Beanstalk* or read the optional book. Hand out some “magic” beans (see materials) and ask, “What do you think is the secret to growing tall bean plants?” Explain that although magic may have influenced the growth of Jack’s plants, scientists do know that other important factors contribute to plant growth.

As a class, generate a list of general factors (light, temperature, water, growing space, etc.) that students think green plants need to stay alive. Label it “All Green Plants Need.” Next to each factor, ask students to predict what specific conditions they think might result in the tallest bean plants. For example, if sunlight is a factor perhaps students predict ten hours per day. Accept all student suggestions whether or not you think they are correct. If students need help finding



ideas, have them look through *Unearthing Garden Mysteries: Experiments for Kids* by Ellen Talmage.

Ask students how they might explore which of these conditions would help grow the tallest bean plants.

Summary of Content and Teaching Strategies

Challenge small groups of students to choose one of the predicted factors for growing the tallest bean plants generated in the interest approach (light, water, temperature, good soil, etc.). To test predictions, have each group of students design an experiment, lasting up to four weeks. Use Handout A to help



guide the learning process. Students use notebook paper to record regular observations. (Younger children will need help setting up experiments, observing, and recording data.) Example work process: Group A and B might each have two plants. The plants in Group A get 24 hours of light while the plants in Group B, the control, get 14 hours of light. A control is used to minimize the effects of variables other than the one being tested. In this example the control is 14 hours of light because plants receive roughly 14 hours of light a day during the summer months.

Before groups of students set up experiments, have each group present its design for review by the class. Have students explain why they predict their particular conditions will improve plant growth. For example, “We think 24 hours of light will make the beans grow taller in four weeks, because we know they need light to make food. So the more light, the more food, and the taller the plant.”

Have each group decide how they’ll gather their data. Suggest that at the end of each week students graph the daily growth rate of their plant and predict, based on the growth rate, how tall their plant will be by the end of the next week. On the graph, illustrate both predictions and actual growth rate results.

After four weeks of experimenting, have each older student group present a three-minute “news conference” to the class highlighting its findings. Suggest a title such as “Grade ____ Scientists Find That ____ May Have Contributed to Jack’s Mammoth Beanstalk.” Have students use creative summary charts and graphs to present data.

Encourage other class members to review the findings and ask questions about the nature of the experiment, conclusions, etc. For example, “Why did you plant X number of seeds in each pot? How did you treat each of your groups? What might you do differently if you were to repeat the experiment? How do you know it was not _____ that affected your plants?”

Combine results from different experiments on a class chart. Use Teacher Material A if desired. Refer to the chart when discussing the Review/Summary questions.



Review/Summary

Review the following questions with the class:

- Were there growing conditions the tallest plants seemed to have in common? What seemed to contribute most to the height of bean plants?
- Did any of your findings surprise you? Which ones?
- Did the tallest plants seem to be the healthiest plants? Explain your response. Do you think bigger is necessarily better? Why or why not?
- How did the data from the whole group help give us a better understanding of conditions for good bean plant growth?

Modifications/Extensions

Devise an experiment to grow the smallest bean plant that will produce flowers.

Replant beans harvested from your stalks. (Wait to replant seeds until pods have dried, about four weeks after the beans were ripe.) Notice whether the seeds from the biggest plants produce bigger offspring.

Rewrite or act out a new version of *Jack and the Beanstalk* using some of the new information gained from your exploration. Post these “techno-tales” around the room.

Sources/Credits

Adapted from the National Gardening Association’s *Grow Lab Activities for Growing Minds*, second edition, copyright 2009. For information on obtaining a copy of their curriculum, visit www.gardeningwithkids.org.

Class Results

Question/
Hypothesis

Experimental
Findings

Comments/New
Questions

Group A			
Group B			
Group C			
Group D			
Group E			

Name _____



Magic Beans Problem Solving

Use these two pages to guide you through the stages of problem solving.

Plant a Question

Hmm, I wonder what will happen if...

Sprout a Hypothesis

I think... the more I water plants, the faster they'll grow

Describe Your Growing Exploration

What steps will I take to find the answer?

Which is the control group?

Oh, I need to remember to change only one factor and keep the others constant!

Let's see... what materials will I need?

What will I observe? How often?

Did I remember repetition? Did I remember repetition?

Record Fruitful Observations:

(attach all record sheets)

Harvest Your Findings:

What happened?
How can I explain it?

Oops, maybe I
should be more
careful about...

On Growing Review:

What else could have
affected my results?

Next time, I'm
going to...

Cultivating New Ideas

This makes me
wonder about...

I still have
questions about...

Now I would
like to try...